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(54) **AIR CONDITIONING/VENTILATING SYSTEM**

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(57) **ABSTRACT**

The ventilating air-conditioning system includes an air supply fan; an exhaust fan; a compressor; a first heat exchanger heat-exchanging between outdoor air sent from the air supply fan and a refrigerant; an expansion mechanism; a second heat exchanger heat-exchanging between air in a sanitary space sent by the exhaust fan and a refrigerant; and a refrigerant circuit piped so that a refrigerant circulates in order of the compressor, first heat exchanger, expansion mechanism, and second heat exchanger, or in order of the compressor, second heat exchanger, expansion mechanism, and first heat exchanger. The system heats or cools an indoor space while ventilating a sanitary space by transferring heat between the first heat exchanger and second heat exchanger through a refrigerant.

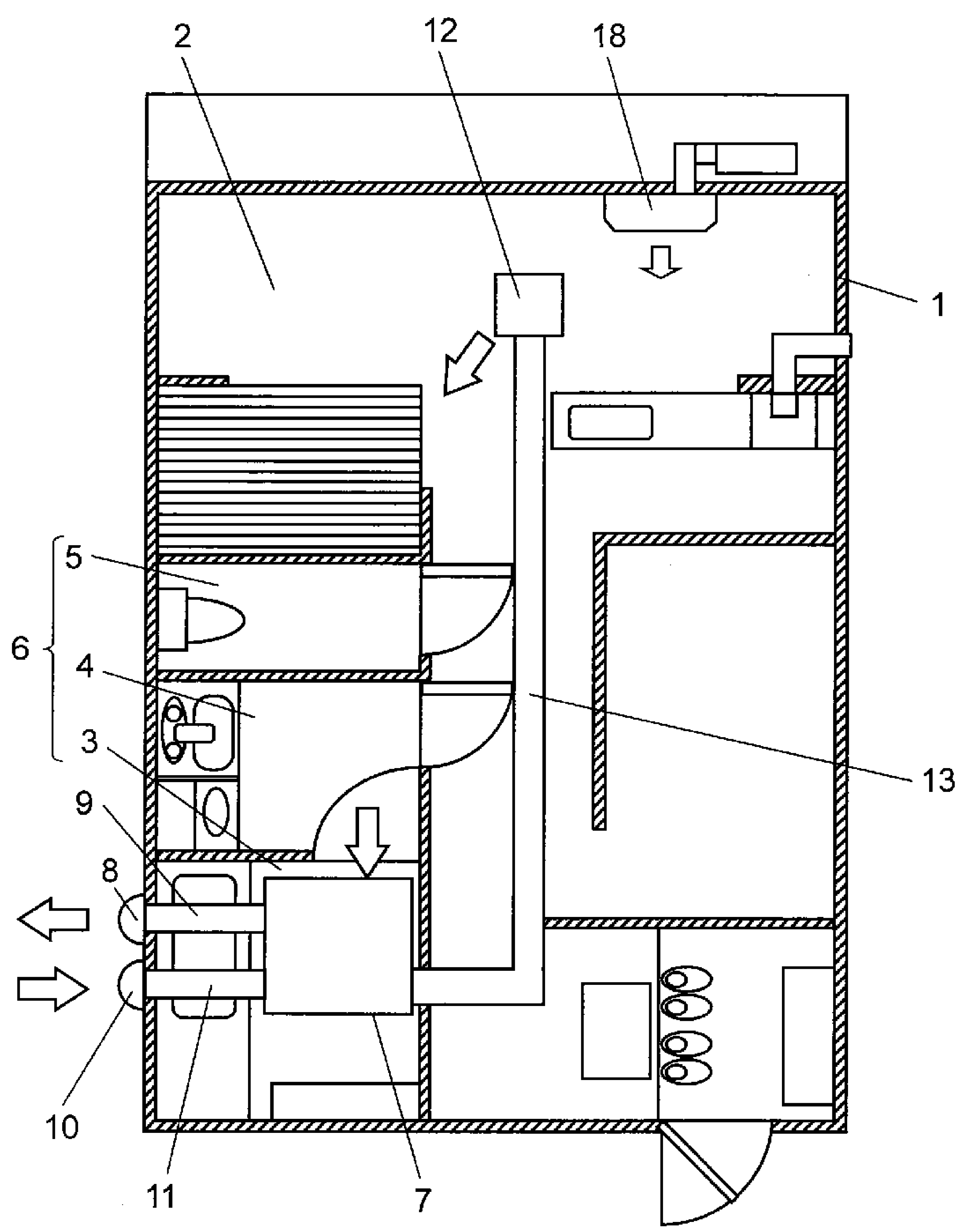

FIG. 1

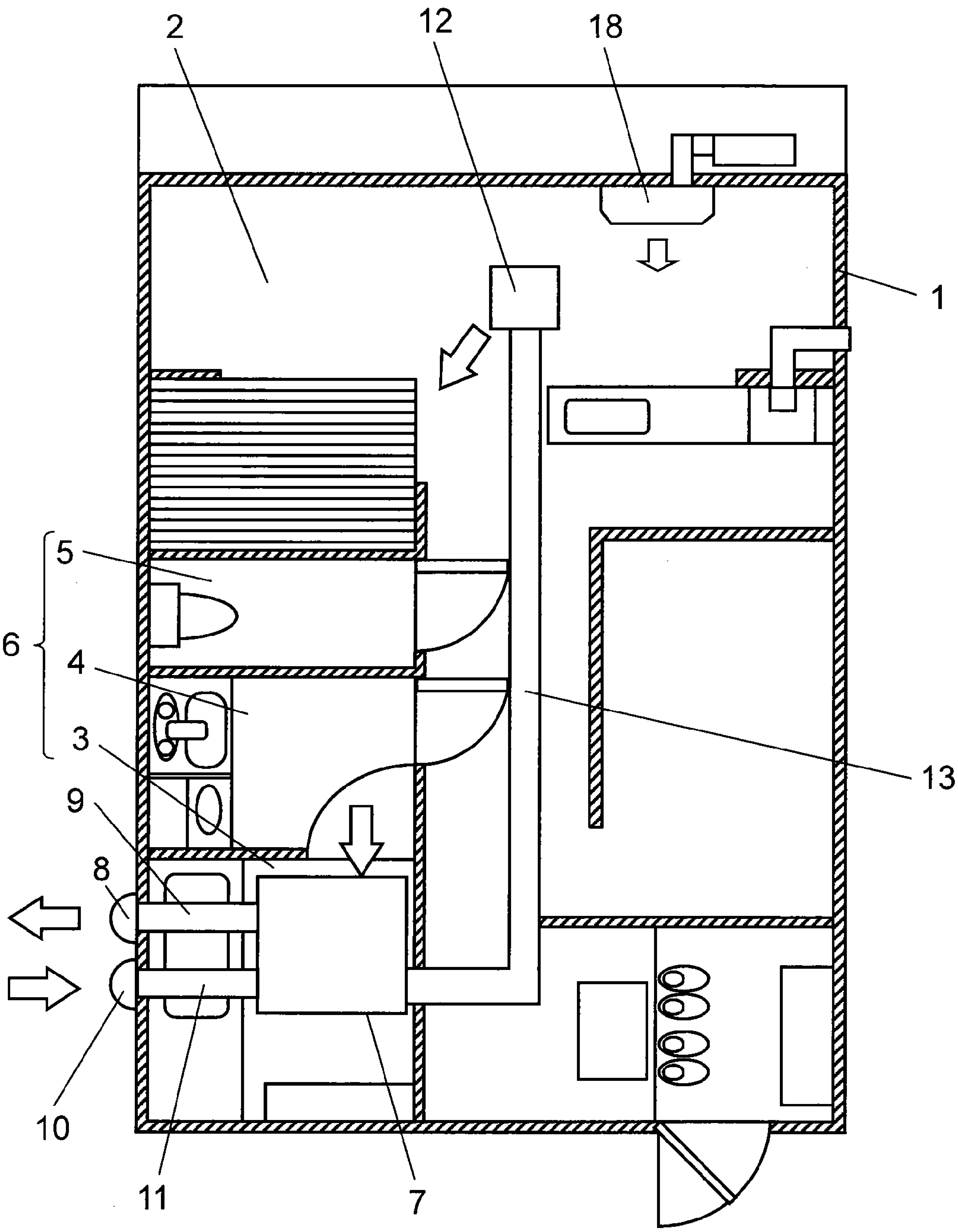

FIG. 2

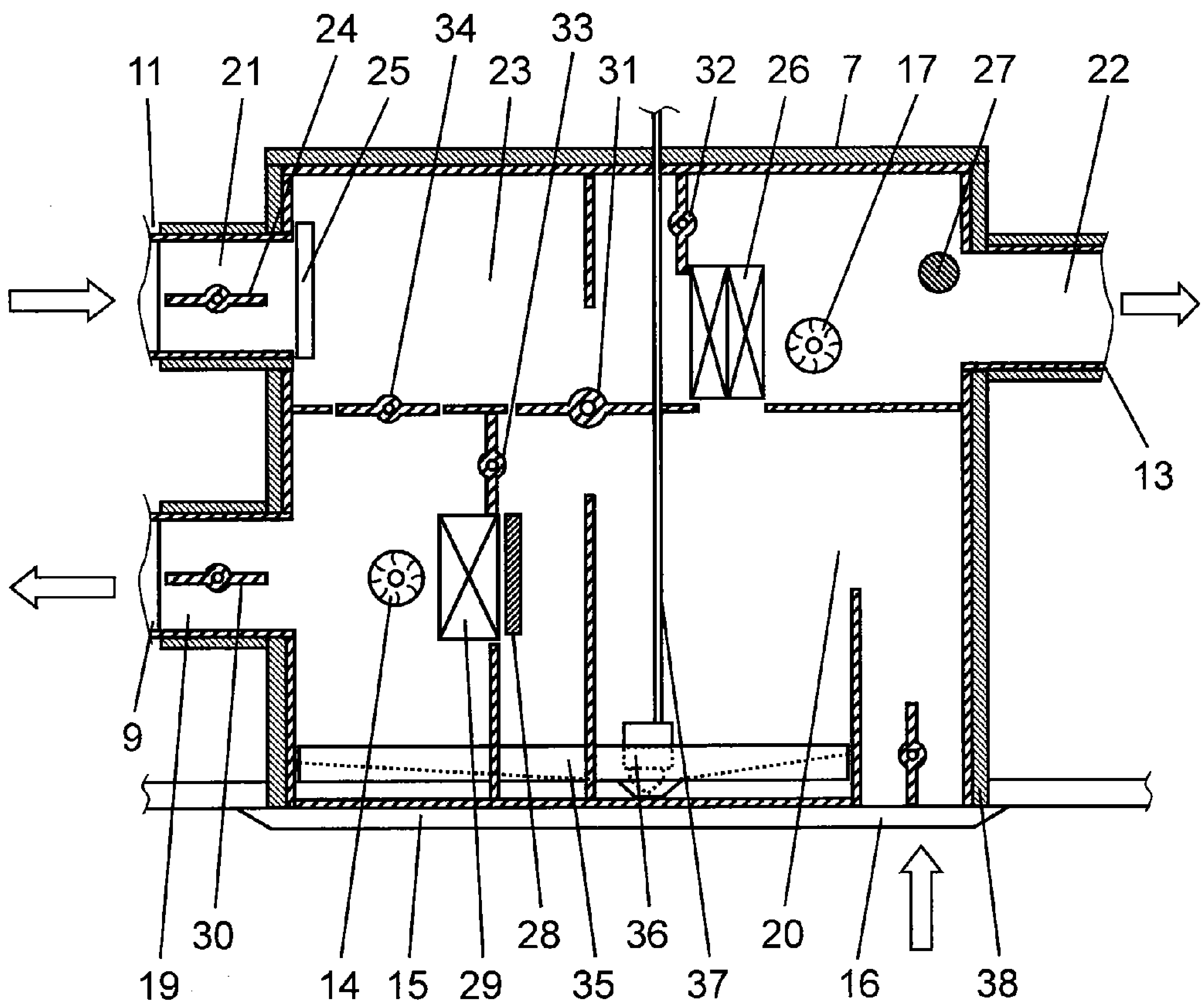

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FIG. 3

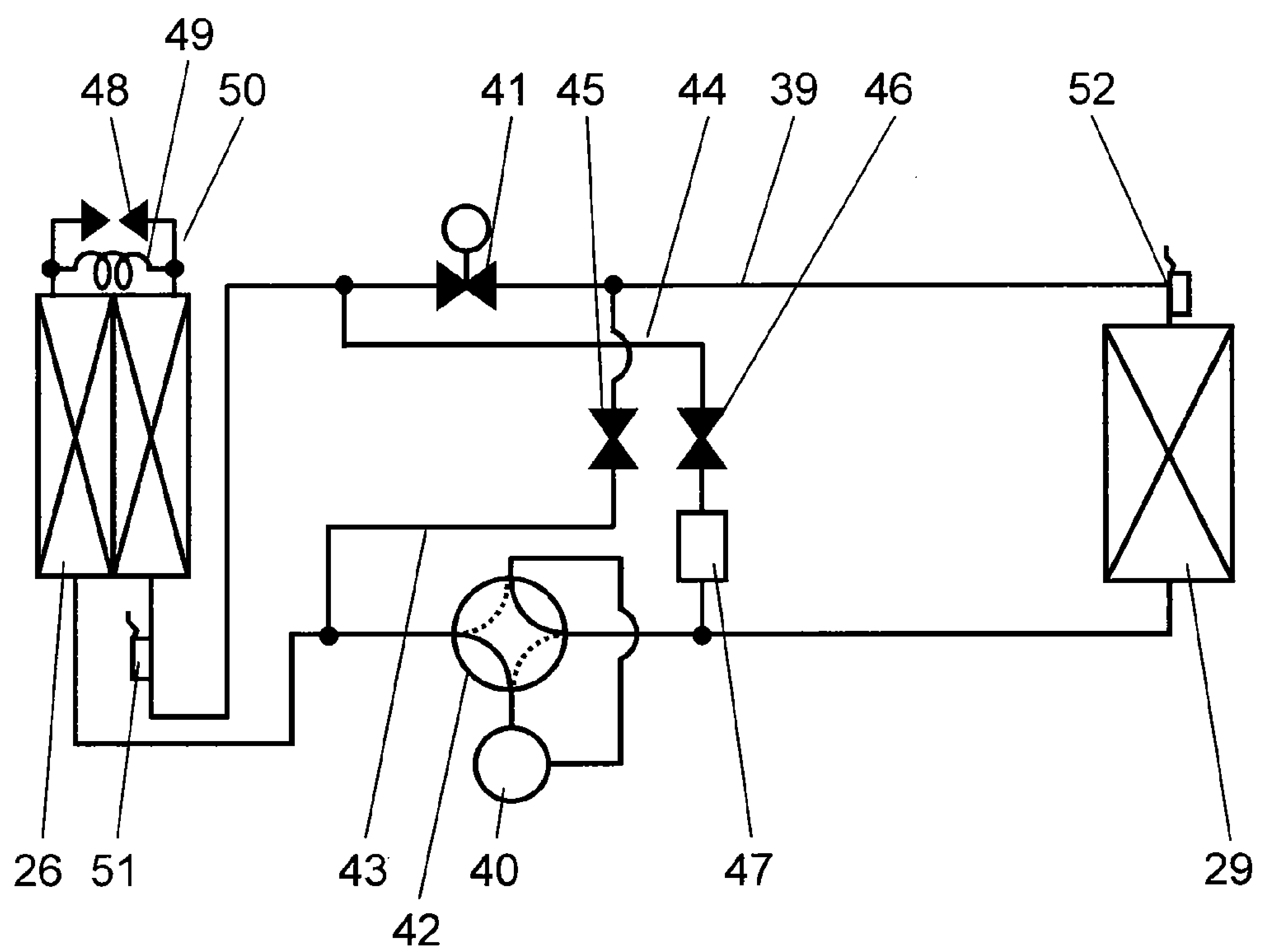


FIG. 4

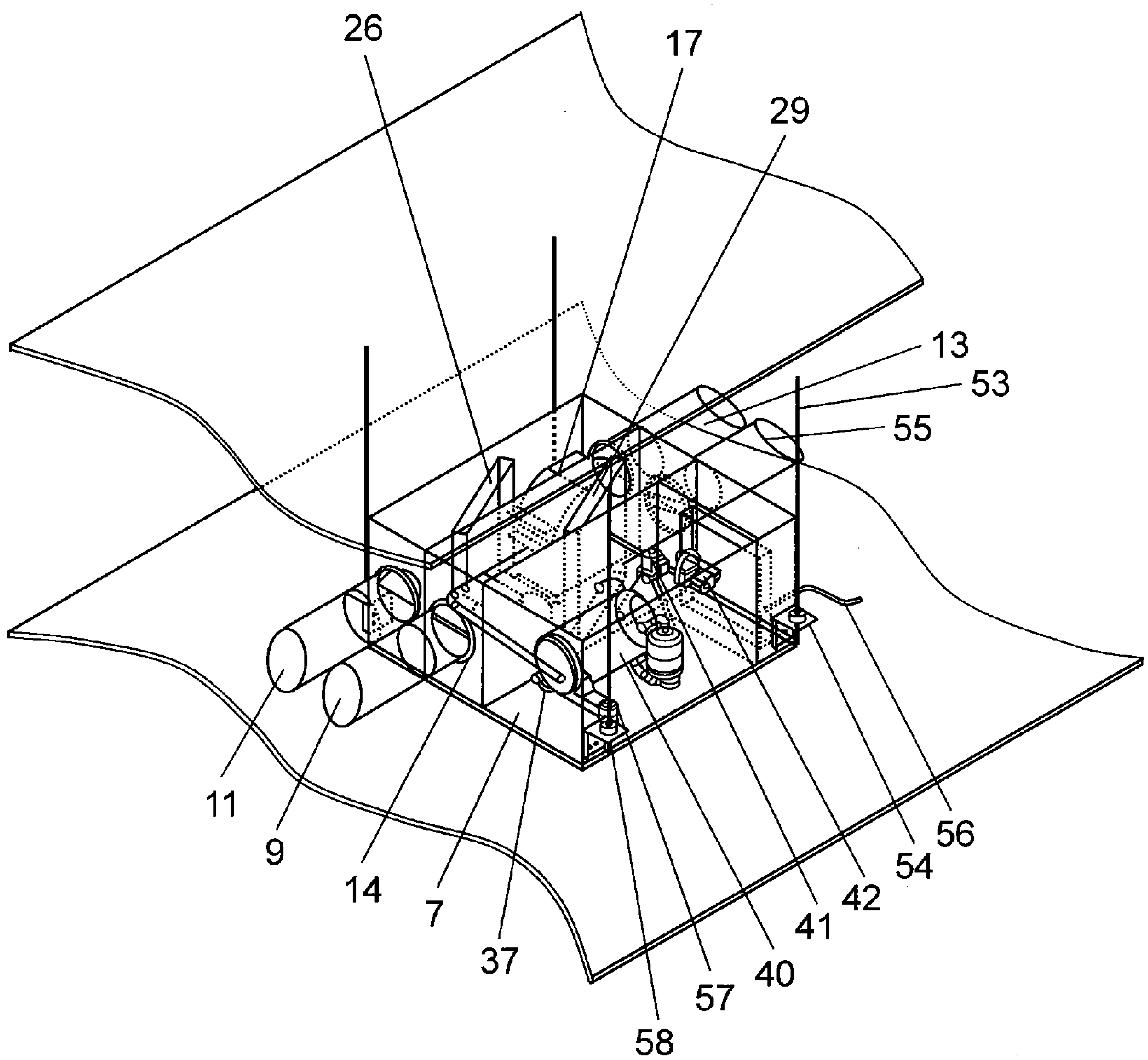


FIG. 5

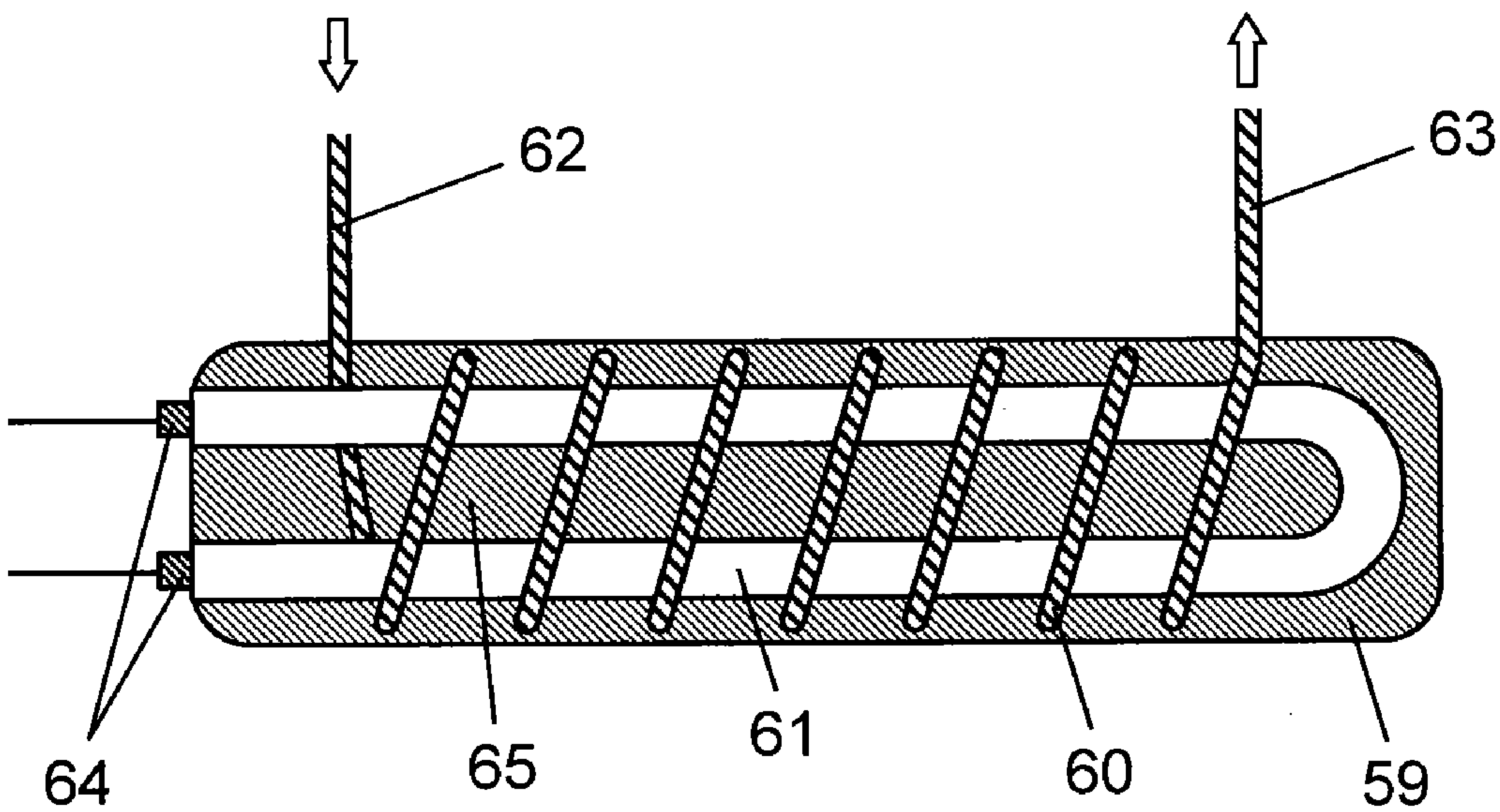
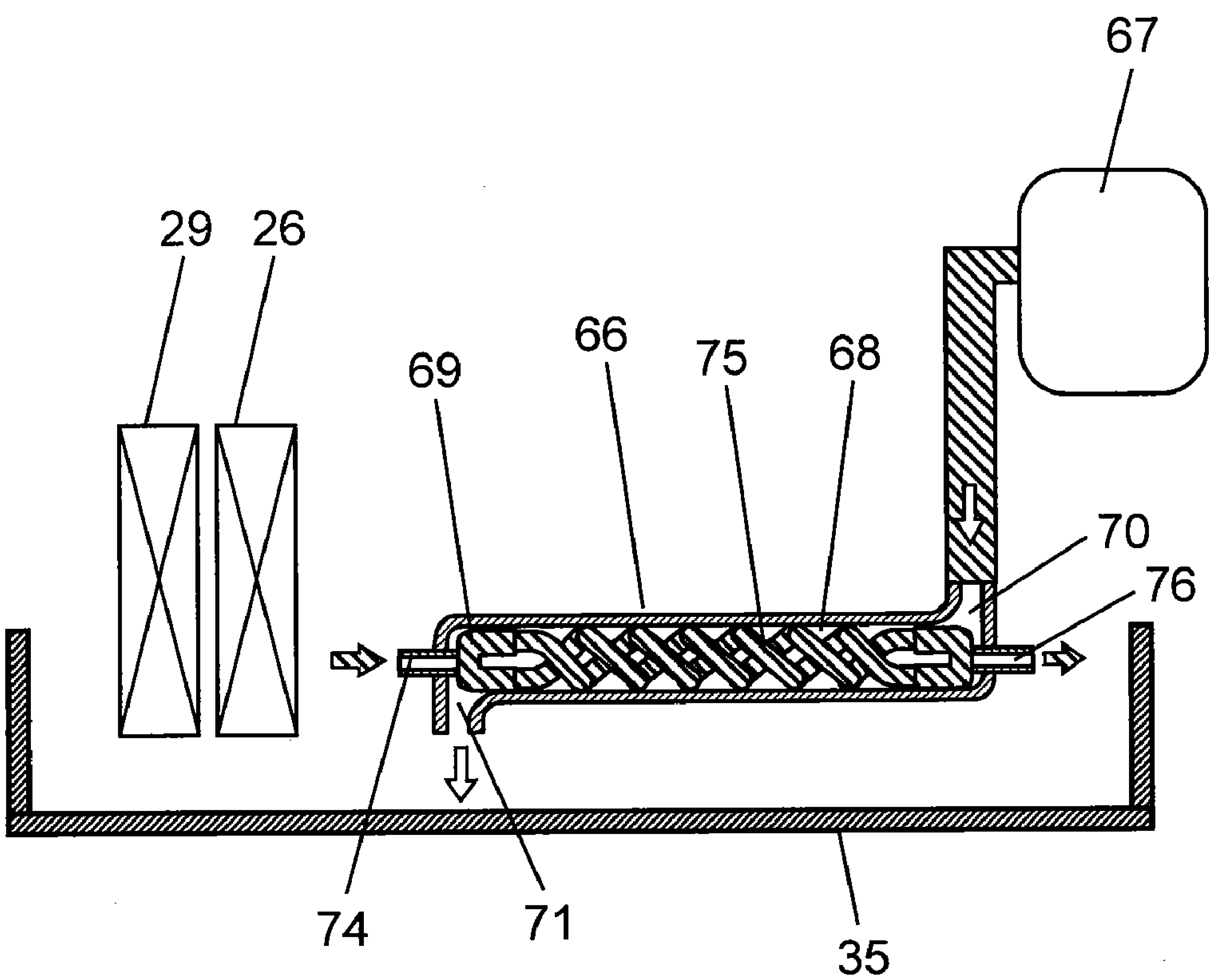


FIG. 6



AIR CONDITIONING/VENTILATING SYSTEM

TECHNICAL FIELD

[0001] The present invention relates to a ventilating air-conditioning system using a heat pump to ventilate and to air-condition a sanitary space such as a bathroom.

BACKGROUND ART

[0002] With a conventional ventilating air-conditioning system such as for a bathroom using a heat pump, one heat exchanger of the heat pump discharges or absorbs heat to or from air introduced from an indoor space other than the bathroom. With some systems, the air is blown out into the bathroom, and at the same time the other heat exchanger of the heat pump discharges or absorbs heat to or from air discharged from the bathroom to the outdoors to air-condition the bathroom during ventilation (refer to patent literature 1, for instance).

[0003] With other systems, the heat pump is separated into outdoor and indoor units, and a heat exchanger placed in the outdoor unit discharges or absorbs heat to or from outdoor air. A heat exchanger placed in the indoor unit discharges or absorbs heat to or from air in the bathroom to air-condition the bathroom, and a ventilating blower placed in the indoor unit ventilates the bathroom (refer to patent literature 2, for instance).

[0004] With yet other systems, an indoor heat pump unit separated from the outdoor unit is provided with a sensible heat exchange ventilation element, which sensibly heat-exchanges during ventilation (refer to patent literature 3, for instance).

[0005] As described above, various types of ventilating air-conditioning systems are devised such as for a bathroom using a heat pump. The bathroom air-conditioning system exemplified in patent literature 1 recovers heat from air discharged from the bathroom to the outdoors during ventilation to condition air in an indoor space other than the bathroom and to supply the air into the bathroom. In this case, outdoor air flows into the indoor space other than the bathroom to cause the following problems. That is, comfort is impaired due to such as draft feeling; mold grows due to condensation near a natural air inlet; and a wall surface becomes dirty due to dust in outdoor air.

[0006] [Patent literature 1] Japanese Patent Unexamined Publication No. 2005-180712

[0007] [Patent literature 2] Japanese Patent Unexamined Publication No. 2002-349930

[0008] [Patent literature 3] Japanese Patent Unexamined Publication No. H09-53840

SUMMARY OF THE INVENTION

[0009] A ventilating air-conditioning system of the present invention includes an air supply fan that draws in outdoor air through an air inlet open to the outdoors and blows out the outdoor air through an air outlet open to an indoor space; an exhaust fan that draws in air in a sanitary space through an inlet open to the sanitary space and blows out the air in the sanitary space through an air outlet open to the outdoors; a compressor that compresses a refrigerant; a first heat exchanger that heat-exchanges between outdoor air sent by the air supply fan and the refrigerant; an expansion mechanism that expands the refrigerant; a second heat exchanger that heat-exchanges between air in the sanitary space sent by the exhaust fan and the refrigerant; and a refrigerant circuit piped so that the refrigerant circulates in order of the compressor, first heat exchanger, expansion mechanism, and second heat exchanger, or in order of the compressor, second heat exchanger, expansion mechanism, and first heat exchanger. The system transfers heat between the first and second heat exchangers through the refrigerant to heat or cool the indoor space while ventilating the sanitary space.

[0010] Such a ventilating air-conditioning system prevents outdoor air not conditioned from flowing into an indoor space, thereby improving comfort, preventing mold from growing due to condensation near a natural air inlet, and preventing a wall surface from becoming dirty due to dust in outdoor air.

BRIEF DESCRIPTION OF DRAWINGS

[0011] FIG. **1** is a sketch of an indoor space where a ventilating air-conditioning system according to an embodiment of the present invention is placed.

[0012] FIG. **2** is a configuration diagram of the air path of the ventilating air-conditioning system.

[0013] FIG. **3** is a diagram of the refrigerant circuit of the ventilating air-conditioning system.

[0014] FIG. **4** is a working diagram of the ventilating air-conditioning system.

[0015] FIG. **5** is an outline block diagram of the refrigerant heater of the ventilating air-conditioning system.

[0016] FIG. **6** is an outline sectional view of the refrigerant-water heat exchanger of the ventilating air-conditioning system.

REFERENCE MARKS IN THE DRAWINGS

[0017] **1** Indoor space
[0018] **3** Bathroom
[0019] **4** Washroom
[0020] **5** Toilet
[0021] **6** Sanitary space
[0022] **7** Main body
[0023] **8** Exhaust outlet
[0024] **10** Air supply inlet
[0025] **12** Air outlet
[0026] **14** Exhaust fan
[0027] **16** Air inlet
[0028] **17** Air supply fan
[0029] **18** Air-conditioner
[0030] **20** Exhaust air path
[0031] **23** Supply air path
[0032] **26** First heat exchanger
[0033] **27** Auxiliary heater
[0034] **28** Preheater
[0035] **29** Second heat exchanger
[0036] **31** Air path changing/adjusting unit
[0037] **32** Air supply bypass
[0038] **33** Exhaust bypass
[0039] **34** Dehumidification changer
[0040] **35** Drain unit
[0041] **36** Drain pump
[0042] **38** Heat insulator
[0043] **39** Refrigerant circuit
[0044] **40** Compressor
[0045] **41** Expansion mechanism
[0046] **42** Flow path changing valve

[0047] **43** First bypass circuit

[0048] **44** Second bypass circuit

[0049] **45** First open/close valve

[0050] **46** Second open/close valve

[0051] **47** Refrigerant heater unit

[0052] **48** Open/close mechanism

[0053] **49** Capillary tube

[0054] **51**, **52** Coil temperature sensor

[0055] **59** Refrigerant heater

[0056] **66** Refrigerant-water heat exchanger

[0057] **67** Water heater

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0058] Hereinafter, a description is made of an embodiment of the present invention with reference to the related drawings.

Exemplary Embodiment

[0059] FIG. **1** is a sketch of an indoor space where a ventilating air-conditioning system according to an embodiment of the present invention is placed. Indoor space **1** is partitioned into living room **2**; and sanitary space **6** such as bathroom **3**, washroom **4**, and toilet **5**. The roof space of bathroom **3** is provided therein with main body **7** of the ventilating air-conditioning system.

[0060] Main body **7** is connected to exhaust duct **9** communicating between main body **7** and exhaust outlet **8** open to the outdoors; air supply duct **11** communicating between main body **7** and air supply inlet **10** open to the outdoors; and air outlet duct **13** communicating between main body **7** and air outlet **12** open to the ceiling of living room **2**.

[0061] FIG. **2** is a configuration diagram of the air path of the ventilating air-conditioning system of the present invention. Main body **7** has exhaust fan **14** disposed therein, and exhaust fan **14** is provided with exhaust connection unit **19** connecting exhaust duct **9** at the air outlet side of exhaust fan **14**. Main body **7** has exhaust air path **20** formed therein communicating between exhaust connection unit **19** and air inlet **16** of grill **15** placed in the ceiling surface of bathroom **3**. Hence, operating exhaust fan **14** causes air in bathroom **3** to be drawn into exhaust fan **14** through air inlet **16** and to be discharged to the outdoors through exhaust duct **9**.

[0062] Main body **7** has air supply fan **17** disposed therein, and air supply fan **17** has air supply connection unit **21** connecting air supply duct **11** provided at the inlet side of air supply fan **17**. Air supply fan **17** has air outlet connection unit **22** connecting air outlet duct **13** provided at the air outlet side of air supply fan **17**, and main body **7** has supply air path **23** communicating between air supply connection unit **21** and air outlet connection unit **22** formed inside main body **7**. Hence, operating air supply fan **17** causes outdoor air to be drawn into air supply fan **17** through air supply duct **11** and to be blown out to living room **2** through air outlet duct **13**.

[0063] Then, continuously operating exhaust fan **14** and air supply fan **17** causes fresh outdoor air to be supplied into living room **2**, and the outdoor air flows into bathroom **3** through louvers or an undercut of the door to bathroom **3**. Then, vapor and smell in bathroom **3** are drawn through air inlet **16** of grill **15** and discharged to the outdoors.

[0064] The air supply and exhaust operation needs to be continuously performed for a building with high hermeticity (24-hour ventilation). Exhaust fan **14** and air supply fan **17** are continuously operated so that a predetermined amount (e.g. approximately a half volume of indoor space **1** per hour) of air supply and exhaust is secured. Living room **2** has air-conditioner **18** placed therein for controlling the room temperature, which appropriately maintains the temperature of the room through cooling operation in summer or heating operation in winter. Hence as described above, with year-round continuous ventilating operation, low-temperature air cooled by air-conditioner **18** in living room **2** is drawn into air inlet **16** through louvers or an undercut of the door to bathroom **3** in summer; and high-temperature air heated, in winter. Then, the cooled or heated air is discharged to the outdoors through main body **7** of the ventilating air-conditioning system.

[0065] The bottom of main body **7** of the ventilating air-conditioning system has air inlet **16** therein of grill **15** open to the ceiling surface of bathroom **3**, and air inlet **16** has an indoor filter (not shown) detachably disposed thereon for collecting dust.

[0066] The inside of supply air path **23** is provided at its upstream side from air supply fan **17** with supply air open/close device **24** opening and closing supply air path **23** (the degree of opening is adjustable); detachable outdoor filter **25** for collecting outdoor dust; and first heat exchanger **26** heat-exchanging mainly between outdoor air and a refrigerant, in order starting from air supply connection unit **21**. At the downstream side from air supply fan **17**, auxiliary heater **27** heating at least part of outdoor air sent by air supply fan **17** is provided.

[0067] The inside of exhaust air path **20** is provided at its upstream side from exhaust fan **14** with preheater **28** preheating air drawn from bathroom **3**; and second heat exchanger **29** heat-exchanging mainly between the drawn air and the refrigerant, in order starting from air inlet **16**. At the downstream side from exhaust fan **14**, exhaust open/close device **30** opening and closing exhaust air path **20** (the degree of opening is adjustable) is provided.

[0068] Supply air path **23** is provided therein with air path changing/adjusting unit **31** communicating or blocking between the upstream side of first heat exchanger **26** and the upstream side of second heat exchanger **29** in exhaust air path **20**, or adjusting the amount of communication.

[0069] Supply air path **23** is provided therein with air supply bypass **32** blowing part of the outdoor air into living room **2** not through first heat exchanger **26**. Exhaust air path **20** is provided therein with exhaust bypass **33** discharging part of the bathroom air to the outdoors not through second heat exchange **29**.

[0070] Exhaust air path **20** is provided therein with dehumidification changer **34** communicating or blocking between the downstream side from second heat exchanger **29** and the upstream side from first heat exchanger **26** in supply air path **23**, or adjusting the amount of communication.

[0071] Supply air path **23** and exhaust air path **20** are provided on their bottoms with drain unit **35** inclined at its bottom, for draining or vaporizing a large amount of dew condensation water generated in the first and second heat exchangers after the water is temporarily stored. Drain unit **35** is provided at its deepest part with drain pump **36** for draining water stored in drain unit **35**, thereby allowing the water to be drained to a position higher than main body **7** through drain piping **37**.

[0072] The outer shell of main body **7** including supply air path **23** and exhaust air path **20** is heat-insulated with heat insulator **38** stuck to the outer shell.

[0073] FIG. **3** is a diagram of the refrigerant circuit of the ventilating air-conditioning system according to the embodiment of the present invention. Main body **7** is provided therein with refrigerant circuit **39** filled with a refrigerant such as any one of an HCFC refrigerant (contains atoms of chlorine, hydrogen, fluorine, and carbon in molecules); an HFC refrigerant (contains atoms of hydrogen, carbon, and fluorine in molecules); and a natural refrigerant (e.g. hydrocarbon, carbon dioxide). Refrigerant circuit **39** includes compressor **40** compressing a refrigerant; first heat exchanger **26**; expansion mechanism **41** composed of an electronic expansion valve expanding the refrigerant; and second heat exchanger **29**.

[0074] Refrigerant circuit **39** includes a path (heating cycle, hereinafter) through which a refrigerant compressed by compressor **40** passes in order of first heat exchanger **26**, expansion mechanism **41**, and second heat exchanger **29**, and then returns to compressor **40**. Refrigerant circuit **39** includes a path (cooling cycle, hereinafter) through which a refrigerant compressed by compressor **40** passes in order of second heat exchanger **29**, expansion mechanism **41**, first heat exchanger **26**, and then returns to compressor **40**. Further, refrigerant circuit **39** is provided with flow path changing valve **42** changing between the heating cycle and cooling cycle.

[0075] Refrigerant circuit **39** is provided with first bypass circuit **43** split from the piping connecting flow path changing valve **42** to first heat exchanger **26**, and joining the piping connecting expansion mechanism **41** to second heat exchanger **29**. Refrigerant circuit **39** is provided with second bypass circuit **44** split from the piping connecting first heat exchanger **26** to flow path changing valve **42**, and joining the piping connecting second heat exchanger **29** to flow path changing valve **42**. First bypass circuit **43** is provided with first open/close valve **45** opening and closing first bypass circuit **43**, and second bypass circuit **44** is provided with second open/close valve **46** opening and closing second bypass circuit **44** and refrigerant heater unit **47** heating a refrigerant. For refrigerant heater unit **47**, refrigerant heater **59** shown in FIG. **5** and refrigerant-water heat exchanger **66** shown in FIG. **6** can be used.

[0076] First heat exchanger **26** is placed in supply air path **23**; second heat exchanger **29**, in exhaust air path **20**. Hence, the refrigerant discharges or absorbs heat mainly to or from outdoor air sent by air supply fan **17**, in first heat exchanger **26**; mainly to or from air discharged from bathroom **3** to the outdoors by exhaust fan **14**, in second heat exchanger **29**.

[0077] The piping through which a refrigerant in first heat exchanger **26** flows is equipped with decompression unit **50** composed of open/close mechanism **48** and capillary tube **49**. When flow path changing valve **42** changes the flow direction of the refrigerant to the heating cycle shown by the solid line, outdoor air sent by air supply fan **17** heat-exchanges with a refrigerant flowing through first heat exchanger **26** at the downstream side from decompression unit **50**. After that, the outdoor air heat-exchanges with a refrigerant flowing at the upstream side from decompression unit **50**.

[0078] Further, the inside of exhaust air path **20** is provided at its upstream side from second heat exchanger **29** with preheater **28** having self temperature controllability. Activating preheater **28** causes air drawn from bathroom **3** into exhaust air path **20** to be heated and to be supplied to second heat exchanger **29**.

[0079] First heat exchanger **26** and second heat exchanger **29** are provided at their expansion mechanism **41** side with coil temperature sensors **51**, **52** detecting the temperature of a refrigerant.

[0080] In this way, the ventilating air-conditioning system according to the embodiment of the present invention thus transfers heat through a refrigerant between first heat exchanger **26** and second heat exchanger **29**, and heats or cools indoor space **1** while ventilating sanitary space **6** such as bathroom **3**.

[0081] FIG. **4** is a working diagram of the ventilating air-conditioning system according to the embodiment of the present invention. Hanging hook **54** of main body **7** is hung on bolt **53** placed at the roof space to suspend main body **7** so as not to contact the ceiling surface. With the ventilating air-conditioning system of FIG. **4**, air drawn from bathroom **3** is assumed to be conveyed into main body **7** through inlet duct **55**, which is different from the configuration of FIG. **2**.

[0082] Main body **7** is connected to air outlet duct **13**, air supply duct **11**, and exhaust duct **9** for conveying air, and is connected to drain piping **37** for draining dew condensation water and power line **56** for supplying electric power.

[0083] Further, main body **7** is provided therein with refrigerant circuit **39** sequentially linking at least compressor **40**, flow path changing valve **42**, first heat exchanger **26**, expansion mechanism **41**, and second heat exchanger **29**. Compressor **40** has two rotors and is placed in a horizontal position to reduce vibration of main body **7** and to decrease the height of main body **7**.

[0084] Main body **7** includes vibration isolator **57** to further absorb vibration of compressor **40**, and bolt **53** includes vibration isolator **58** to suppress vibration propagating to the frame of main body **7**.

[0085] FIG. **5** is an outline block diagram of the refrigerant heater of the ventilating air-conditioning system according to the embodiment of the present invention. Refrigerant heater **59** is composed of refrigerant pipe line **60** made of refrigerant piping coiled for conducting a refrigerant; electrothermal tube **61** placed in a U-shaped form at the inner circumferential side of coiled refrigerant pipe line **60**; and heat transfer cylinder **65** formed in a solid cylinder-shaped form by casting a metallic material (e.g. aluminum) so as to cover all the surface except inlet **62** and outlet **63** of refrigerant pipe line **60**; and terminals **64** of electrothermal tube **61**.

[0086] When a predetermined voltage is applied between terminals **64** of electrothermal tube **61**, electrothermal tube **61** generates heat, which then transfers through the inside of heat transfer cylinder **65** to heat refrigerant pipe line **60** disposed on the outer circumference of electrothermal tube **61**. The refrigerant is introduced into refrigerant pipe line **60** through inlet **62**. In the process of the refrigerant flowing through the coiled part of refrigerant pipe line **60** where its outer circumference is covered with heat transfer cylinder **65**, the refrigerant is heated through heat transfer cylinder **65**, and then led to outlet **63**. Electrothermal tube **61** placed at the core of heat transfer cylinder **65** generates heat toward refrigerant pipe line **60** placed in the outer circumferential direction of heat transfer cylinder **65**, and thus a small amount of heat leaks outside. Heat generated by electrothermal tube **61** transfers through heat transfer cylinder **65** to uniformly heat refrigerant pipe line **60**, thereby improving the heating efficiency and downsizing refrigerant heater unit **47**.

[0087] FIG. **6** is an outline sectional view of the refrigerant-water heat exchanger of the ventilating air-conditioning system according to the embodiment of the present invention. Refrigerant-water heat exchanger **66** has a dual-pipe structure, with refrigerant pipe line **69** (through which a refrigerant flows) disposed inside hot-water pipe line **68** (through which hot water from water heater **67** flows). Refrigerant pipe line **69** is split into two parts inside hot-water pipe line **68**, and formed in a twisted manner (split refrigerant pipe line **69** is helically twisted), thereby increasing the heat transfer area to improve the heat exchange efficiency.

[0088] Next, the hot water that has flown from hot-water flow-in part **70** of hot-water pipe line **68** into refrigerant-water heat exchanger **66** flows through the outer circumference of refrigerant pipe line **69**; flows out from hot-water flow-out part **71** outside refrigerant-water heat exchanger **66**; and then drops into drain unit **35** underneath hot-water flow-out part **71**. Drain unit **35** doubles as a drain tray for dew condensation water generated at first heat exchanger **26** and second heat exchanger **29**. The hot water that has dropped into drain unit **35** is drained together with drain water outside main body **7** through drain piping **37** by drain pump **36**. In this way, hot water that has heat-exchanged with the refrigerant is drained through drain unit **35**.

[0089] Meanwhile, the refrigerant that has flown into refrigerant-water heat exchanger **66** from refrigerant flow-in part **74** of refrigerant pipe line **69** faces the flow of hot water to split into twisted tube **75**. Here, the refrigerant is heated by heat exchange with the hot water and flows out through refrigerant flow-out part **76**. The hot water used for heating the refrigerant may be heated by whichever type of water heater: combustion or heat pump. A heat pump water heater, using atmospheric heat, further improves the heating efficiency of refrigerant heater unit **47** and lowers the running cost.

[0090] Still, with a structure that returns water discharged from hot-water flow-out part **71** to water heater **67**, hot-water pipe line **68** can be supplied with circulating water for heating, not with hot water heated by water heater **67**.

[0091] Instead, hot-water pipe line **68** may be supplied with normal-temperature feed water directly, not with high-temperature water heated by a water heater. In this case, with flow path changing valve **42** changed to the cooling cycle and second open/close valve **46** set to the open state, refrigerant circuit **39** is supplied with a high-temperature, high-pressure refrigerant compressed by compressor **40**, which enables the refrigerant to be cooled in a process of heat exchange with normal-temperature water such as tap water. In this way, refrigerant-water heat exchanger **66** may be supplied with normal-temperature water to be made heat-exchange with the refrigerant.

[0092] Next, a description is made of operation of the ventilating air-conditioning system. Tables 1, 2 list operating states in each operation pattern.

[0093] [Table 1]

[0094] [Table 2]

[0095] The lists of tables 1, 2 describe each operation pattern of the ventilating air-conditioning system in sequence column-wise, and operating states of main components in each operation pattern are described row-wise. As shown in the lists, this ventilating air-conditioning system can execute 10 different operation patterns: heat-exchanging ventilation operation, air supply/exhaust operation, air supply operation, exhaust operation, dehumidification operation, heating operation, cooling operation, heat-exchanging ventilation operation while slightly dehumidifying, heat-exchanging ventilation operation while slightly heating, and heat-exchanging ventilation operation while slightly cooling.

[0096] The heat-exchanging ventilation operation is an operation pattern in which, while rapidly discharging smell and moisture in sanitary space **6**, heat of air conditioned by such as air-conditioner **18** when outdoor fresh air is supplied into indoor space **1** is recovered into a refrigerant when exhausting; air supplied from the outdoors is heated by the refrigerant; and the air is supplied with its temperature and humidity brought to those of conditioned air in indoor space **1**. In this operation, exhaust fan **14** is set to “strong notch” (capable of rapid exhaust); air path changing/adjusting unit **31** is set to the air supply/exhaust position (exhaust air path **20** and supply air path **23** are secured, shown in the figure); and air supply fan **17** is set to “strong notch” (capable of supplying air of the same amount as exhaust).

[0097] Air supply bypass **32**, exhaust bypass **33**, and dehumidification changer **34** are all set to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0098] In refrigerant circuit **39**, compressor **40** is operated at the lowest frequency (extremely low power consumption); flow path changing valve **42** is retained in the heating state in winter and in the cooling state in summer, according to the difference between outdoor and indoor temperatures, for instance; and expansion mechanism **41** is adjusted to an appropriate degree of opening for an optimum refrigeration cycle when needed. Open/close mechanism **48** is set to the open state, and thus the refrigerant does not pass through capillary tube **49**. Refrigerant heater unit **47** is set to the stop state; and first open/close valve **45** and second open/close valve **46**, to the closed state.

[0099] In winter in this state, for instance, exhaust fan **14** is operated at “strong notch”. A large volume of air warmed by air-conditioner **18** in indoor space **1** passes through a hallway and/or the undercut of a door and travels through exhaust air path **20** from air inlet **16** of grill **15** placed in the ceiling together with air containing smell and moisture in sanitary space **6**. Fin-tube-type second heat exchanger **29** that has been changed to a “vaporizer” by flow path changing valve **42** exhausts air with its heat absorbed into the refrigerant to the outdoors through exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8**. Then, operating air supply fan **17** at “strong notch” makes a large volume of outdoor, cold, fresh air be drawn into supply inlet **10** and pass through air supply duct **11**, air supply connection unit **21** of main body **7**, air supply open/close device **24**, outdoor filter **25**, and supply air path **23**. In first heat exchanger **26** that has been changed to a “condenser” as a result that the heating state is retained by flow path changing valve **42**, a refrigerant compressed and conveyed by compressor **40** discharges heat into cold air from the outdoors including heat absorbed from air in second heat exchanger **29** (i.e. “vaporizer”). Consequently, cold air from the outdoors, becoming warm, is blown out from air outlet **12** to living room **2** through air outlet connection unit **22** and air outlet duct **13**.

[0100] The refrigerant is changed to a gas of relatively low pressure and temperature by compressor **40** operated at the lowest frequency; discharged in a small circulation amount; and enters first heat exchanger **26** through flow path changing valve **42**. With open/close mechanism **48** in the open state, the refrigerant discharges heat into a large volume of air from the outdoors at the entire first heat exchanger **26** to decrease its temperature, becoming a low-temperature liquid. Further, the refrigerant is decompressed by expansion mechanism **41** to enter a two-phase state with low pressure and low temperature; absorbs heat from a large volume of air in indoor space **1** at second heat exchanger **29**, becoming a low-pressure, low-temperature gas; and then returns to compressor **40**.

[0101] Moisture in sanitary space **6** condenses into dew condensation water on the fins of second heat exchanger **29** (i.e. "vaporizer") and flows down to drain unit **35**. The accumulated dew condensation water is drained through drain piping **37** to such as the outdoors and a catch basin by operation of drain pump **36**. Alternatively, the dew condensation water is sprayed onto first heat exchanger **26** (i.e. "condenser"), and vaporized and exhausted when air in sanitary space **6** is heat-exchanged.

[0102] Meanwhile, the insulation effect of heat insulator **38** around main body **7** prevents condensation and performance deterioration.

[0103] In summer, a large volume of air cooled by air-conditioner **18** in indoor space **1** enters main body **7** together with air containing smell and moisture in sanitary space **6**; absorbs heat from the refrigerant at second heat exchanger **29** that has been changed to a "condenser" by flow path changing valve **42**; and then discharged to the outdoors. Then, a large volume of outdoor, hot, fresh air enters main body **7**; discharges heat to the refrigerant at first heat exchanger **26** that has been changed to a "vaporizer" as a result that the cooling state is retained by flow path changing valve **42**; and is cooled and blown out into living room **2**.

[0104] In this way, as a result that compressor **40** is operated at the lowest frequency, the refrigerant circulates to first heat exchanger **26** and second heat exchanger **29** with low power consumption; as a result that exhaust fan **14** and air supply fan **17** are operated at "strong notch", a large volume of air is exhausted and supplied, which results in the heat-exchanging ventilation operation in which the heat of exhaust from indoor space **1** is recovered and discharged into the supplied air.

[0105] Next, a description is made of operation when the air supply/exhaust operation is performed. The operation is an operation pattern in which a ventilating air volume regulated by the Building Standards Law is secured for 24 hours and indoor space **1** is supplied with air while sanitary space **6** is exhausted. When the air supply/exhaust operation is performed, exhaust fan **14** is set to "weak notch" (low power consumption); air path changing/adjusting unit **31**, to the air supply/exhaust position (exhaust air path **20** and supply air path **23** are secured, shown in the figure); and air supply fan **17**, to "strong notch" (capable of supplying air of the same amount as exhaust).

[0106] Air supply bypass **32** and exhaust bypass **33** are set to the open state; dehumidification changer **34**, to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0107] Refrigerant circuit **39** stops compressor **40** to prevent a refrigerant from flowing, and thus flow path changing valve **42**, expansion mechanism **41**, open/close mechanism **48**, refrigerant heater unit **47**, first open/close valve **45**, and second open/close valve **46** are all set to the stop state.

[0108] In an intermediate season (e.g. spring, autumn) in this state, for instance, exhaust fan **14** operates at "weak notch", which causes air in indoor space **1** containing such as VOC generated from building materials and furniture to pass through a hallway and/or the undercut of a door. Then, the air travels through air inlet **16** of grill **15** placed in the ceiling of sanitary space **6**, exhaust air path **20**, mainly exhaust bypass **33** in the open state, exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8**, and is discharged to the outdoors. Meanwhile, as a result that air supply fan **17** is operated at "weak notch", outdoor fresh air enters air supply inlet **10** and passes through air supply duct **11**, air supply connection unit **21** of body **7**, air supply opening and closing device **24**, outdoor filter **25**, and supply air path **23**. Then, the outdoor fresh air passes through mainly air supply bypass **32** in the open state, air outlet connection unit **22**, and air outlet duct **13**, and is blown out from air outlet **12** into living room **2**.

[0109] In this way, operating exhaust fan **14** and air supply fan **17** at "weak notch" results in the air supply/exhaust operation in which a small volume of air in indoor space **1** is discharged with extremely low power consumption and outdoor air is supplied.

[0110] Next, a description is made of operation when the air supply operation is performed. The operation is an operation pattern in which indoor space **1** is merely supplied with air when outdoor air provides more comfortable temperature and humidity or when outdoor air is cleaner than indoor. When the air supply operation is performed, exhaust fan **14** is stopped; air path changing/adjusting unit **31** is set to the air supply/exhaust position (exhaust air path **20** and supply air path **23** are secured, the state shown in the figure); and air supply fan **17** is operated at "weak notch" (low power consumption).

[0111] Air supply bypass **32** and exhaust bypass **33** are set to the open state; dehumidification changer **34**, to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0112] Refrigerant circuit **39** stops compressor **40** to prevent the refrigerant from flowing, and thus flow path changing valve **42**, expansion mechanism **41**, open/close mechanism **48**, refrigerant heater unit **47**, first open/close valve **45**, and second open/close valve **46** are all set to the stop state.

[0113] In an intermediate season (e.g. spring, autumn) in this state, for instance, as a result that air supply fan **17** is operated at "weak notch", outdoor fresh air enters air supply inlet **10**. Then, the outdoor fresh air passes through air supply duct **11**, air supply connection unit **21**, air supply open/close device **24**, outdoor filter **25**, and supply air path **23** of main body **7**; through mainly air supply bypass **32** in the open state; through air outlet connection unit **22** and air outlet duct **13**; and then is blown out from air outlet **12** into living room **2**.

[0114] In this way, operating air supply fan **17** at "weak notch" results in the air supply operation in which a small volume of outdoor air is supplied with extremely low power consumption.

[0115] Next, a description is made of operation when the exhaust operation is performed. The operation is an operation pattern in which sanitary space **6** is merely exhausted such as when the environment in indoor space **1** is not changed largely. When the exhaust operation is performed, air supply fan **17** is stopped; air path changing/adjusting unit **31** is set to the air supply/exhaust position (exhaust air path **20** and supply air path **23** are secured, the state shown in the figure); and exhaust fan **14** is operated at "weak notch" (low power consumption).

[0116] Air supply bypass **32** and exhaust bypass **33** are set to the open state; dehumidification changer **34**, to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0117] Refrigerant circuit **39** stops compressor **40** to prevent the refrigerant from flowing, and thus flow path changing valve **42**, expansion mechanism **41**, open/close mechanism **48**, refrigerant heater unit **47**, first open/close valve **45**, and second open/close valve **46** are all set to the stop state.

[0118] In an intermediate season (e.g. spring, autumn) in this state, for instance, exhaust fan **14** operates at "weak notch", which causes air in indoor space **1** containing such as VOC generated from building materials and furniture to pass through a hallway and/or the undercut of a door. Then, the air in indoor space **1** travels through air inlet **16** of grill **15** placed in the ceiling of sanitary space **6**, exhaust air path **20**, mainly exhaust bypass **33** in the open state, exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8**, and is discharged to the outdoors.

[0119] In this way, operating exhaust fan **14** at "weak notch" results in the air exhaust operation in which a small volume of air in sanitary space **6** is discharged with extremely low power consumption.

[0120] Next, a description is made of operation when the dehumidification operation is performed. The operation is an operation pattern used when reheating and dehumidifying indoor space **1** to improve comfort against high humidity during a rainy season or against humidification by households and to restrain mold on such as a wall surface. To perform the dehumidification operation, exhaust fan **14** is stopped; air path changing/adjusting unit **31** is set to the air supply/exhaust position" (exhaust air path **20** and supply air path **23** are secured, the state shown in the figure). During the dehumidification operation, dehumidification changer **34** is set to the open state in which exhaust air path **20** communicates with supply air path **23**; air supply open/close device **24** and exhaust open/close device **30** are set to the closed state; and air supply fan **17** is operated at "strong notch".

[0121] Air supply bypass **32** and exhaust bypass **33** are set to the closed state; and auxiliary heater **27** and preheater **28**, to the stop state.

[0122] Refrigerant circuit **39** operates the compressor at a frequency adjusted according to the temperature and humidity of the air drawn into indoor space **1**; retains flow path changing valve **42** to the heating state; and adjusts expansion mechanism **41** to an appropriate degree of opening for an optimum refrigeration cycle when needed. Open/close mechanism **48** is set to the open state, and thus the refrigerant does not pass through capillary tube **49**. Refrigerant heater unit **47** is set to the stop state; and first open/close valve **45** and second open/close valve **46**, to the closed state.

[0123] In this state, as a result that exhaust open/close device **30** and air supply open/close device **24** are in the closed state and dehumidification changer **34** in the open state, exhaust air path **20** is in a negative pressure when air supply fan **17** operates at "strong notch". A large volume of air containing much moisture in indoor space **1** passes through a hallway and/or the undercut of a door, and flows into exhaust air path **20** from air inlet **16** of grill **15** placed in the ceiling together with air in sanitary space **6**. After that, the large volume of air containing much moisture in indoor space **1** is heat-absorbed and dehumidified by the refrigerant at fin-tube-type second heat exchanger **29** that has been changed to a "vaporizer" by flow path changing valve **42**, and flows into supply duct **23**. Then the large volume of air containing much moisture in indoor space **1** is heated at first heat exchanger **26** that has been changed to a "condenser". The dehumidified air, being warmed, travels through air outlet connection unit **22**, air outlet duct **13**, and is blown out from air outlet **12** into living room **2**.

[0124] The refrigerant is changed to a gas of moderately high pressure and temperature by compressor **40** operating at an appropriate frequency and is discharged to enter first heat exchanger **26** through flow path changing valve **42**. With open/close mechanism **48** in the open state, the refrigerant discharges heat into a large volume of air (its temperature and humidity have been lowered by second heat exchanger **29**) sent from indoor space **1** to lower its temperature, changing into a low-temperature liquid at first heat exchanger **26**. Further, the refrigerant is decompressed by expansion mechanism **41** to enter a two-phase state with low pressure and low temperature; absorbs heat from a large volume of air in indoor space **1** at second heat exchanger **29**, becoming a low-pressure, low-temperature gas; and then returns to compressor **40**.

[0125] Moisture in sanitary space **6** condenses into dew condensation water on the fins of second heat exchanger **29** (i.e. "vaporizer") and flows down to drain unit **35**. The accumulated dew condensation water is drained through drain piping **37** to such as the outdoors and a catch basin by operation of drain pump **36**.

[0126] Meanwhile, the insulation effect of heat insulator **38** around main body **7** prevents condensation and performance deterioration.

[0127] In this way, as a result that compressor **40** is operated at an appropriate frequency, the refrigerant circulates to first heat exchanger **26** and second heat exchanger **29**. As a result that air supply fan **17** is operated at "strong notch" with exhaust open/close device **30** and air supply open/close device **24** in the closed state and with dehumidification changer **34** in the open state, the dehumidification operation is performed in which a large volume of air recovers heat when indoor space **1** is dehumidified and reheats indoor space **1**.

[0128] Next, a description is made of operation when the heating operation is performed. The operation is an operation pattern used to improve comfort by heating indoor space **1** such as in winter or to reduce a heating load on air-conditioner **18**. During the heating operation, air path changing/adjusting unit **31** sets supply air path **23** and exhaust air path **20** to the heating/cooling position at which air supplied from the outdoors passes through first heat exchanger **26**, and exhaust from indoor space **1** passes through second heat exchanger **29**. During the heating operation, exhaust fan **14** and air supply fan **17** are operated at "strong notch".

[0129] Air supply bypass **32**, exhaust bypass **33**, and dehumidification changer **34** are all set to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0130] Refrigerant circuit **39** operates the compressor while adjusting the frequency according to the temperature of the air in indoor space **1** and the outdoors; retains flow path changing valve **42** to the heating state; and adjusts expansion mechanism **41** to an appropriate degree of opening for an optimum refrigeration cycle when needed. Open/close mechanism **48** is set to the open state, and thus the refrigerant does not pass through capillary tube **49**. Refrigerant heater unit **47** is set to the stop state; and first open/close valve **45** and second open/close valve **46**, to the closed state.

[0131] In this state, as a result that exhaust fan **14** is operated at "strong notch", a large volume of air in indoor space **1** passes through a hallway and/or the undercut of a door, and through exhaust air path **20** from air inlet **16** of grill **15** placed in the ceiling together with air in sanitary space **6**. Then, the air that has passed through exhaust air path **20** is heat-discharged from the refrigerant compressed and conveyed by compressor **40**, at fin-tube-type first heat exchanger **26** (i.e. "condenser"). The air that has been heat-discharged from the refrigerant passes through air outlet connection unit **22** and air outlet duct **13** by air path changing/adjusting unit **31** set to the heating/cooling position, and is blown out from air outlet **12** into living room **2**. Then, as a result that air supply fan **17** is operated at "strong notch", a large volume of outdoor air enters air supply inlet **10** and passes through air supply duct **11**, air supply connection unit **21** of main body **7**, air supply open/close device **24**, outdoor filter **25**, and supply air path **23**. The large volume of outdoor air is retained in the heating state by air path changing/adjusting unit **31** set to the heating/cooling position; heat-absorbed by the refrigerant at second heat exchanger **29** that has been changed to a "vaporizer"; and discharged to the outdoors through exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8**.

[0132] The refrigerant is changed to a gas of high pressure and temperature by compressor **40** operating at an appropriate frequency, and is discharged to enter first heat exchanger **26** through flow path changing valve **42**. With open/close mechanism **48** in the open state, the refrigerant discharges heat into a large volume of air sent from indoor space **1** to lower its temperature at entire first heat exchanger **26**, changing into a low-temperature liquid. Further, the refrigerant is decompressed by expansion mechanism **41** to enter a two-phase state with low pressure and low temperature; absorbs heat from a large volume of outdoor air at second heat exchanger **29**, becoming a low-pressure, low-temperature gas; and then returns to compressor **40**.

[0133] Outdoor moisture condenses into dew condensation water on the fins of second heat exchanger **29** (i.e. "vaporizer") and flows down to drain unit **35**. The accumulated dew condensation water is drained through drain piping **37** to such as the outdoors and a catch basin by operation of drain pump **36**.

[0134] Meanwhile, the insulation effect of heat insulator **38** around main body **7** prevents condensation and performance deterioration.

[0135] In this way, as a result that compressor **40** is operated at an appropriate frequency, the refrigerant circulates to first heat exchanger **26** and second heat exchanger **29**. As a result that air path changing/adjusting unit **31** is retained at the heating/cooling position, and exhaust fan **14** and air supply fan **17** are operated at "strong notch", a large volume of air is warmed, which results in the heating operation in which indoor space **1** is heated.

[0136] Further, auxiliary heater **27** can be switched between on and off according to preferences of the user. For instance, if the user feels a draft feeling and sets the system so as to reduce the air volume of air supply fan **17**, the refrigerant discharges less heat as the air volume supplied to first heat exchanger **26** decreases although draft feeling decreases, which lowers the temperature of indoor space **1** to impair comfortable feeling. If auxiliary heater **27** is operated in such a case, the air that has passed through first heat exchanger **26** is further heated by auxiliary heater **27**, and the high-temperature air is supplied to indoor space **1**, thereby suppressing a decrease of the room temperature.

[0137] When outdoor air temperature is extremely low in winter, the temperature of outdoor air supplied to second heat exchanger **29** by exhaust fan **14** is also low, and thus a frosting phenomenon occurs in which frost forms on second heat exchanger **29** while the above-described heating operation is performed. If this frosting state is left, the amount of heat discharge at first heat exchanger **26** decreases as the heat-absorbing performance of second heat exchanger **29** decreases, resulting in indoor space **1** not adequately heated. To suppress such a problem, defrosting operation **1** needs to be performed in which the temperature of the refrigerant piping of second heat exchanger **29** is monitored by coil temperature sensor **52** during the heating operation, and frost formed on second heat exchanger **29** is removed when the temperature decreases below a predetermined level. Next, a description is made of operation when defrosting operation **1** is performed.

[0138] When performing defrosting operation during heating operation, exhaust fan **14** that has been operated at "strong notch" and air supply fan **17** that has been operated at "predetermined notch" are stopped, and flow path changing valve **42** that has been set to the heating state is changed to the cooling operation. With such setting being made, a high-temperature, high-pressure refrigerant compressed by compressor **40** passes through flow path changing valve **42** that has been changed to cooling and is led to second heat exchanger **29**. As a result that this high-temperature refrigerant flows through the refrigerant piping of second heat exchanger **29**, the temperature of the piping rises to dissolve frost formed on the surface. The dissolved frost becomes drain water; drops down to drain unit **35**; and is drained to such as the outdoors and a catch basin through drain pump **36** and drain piping **37**.

[0139] Meanwhile, the refrigerant that has discharged heat and dissolved frost at second heat exchanger **29** flows through expansion mechanism **41**, first heat exchanger **26**, and path changing valve **42** in sequence, and returns to compressor **40** to circulate in refrigerant circuit **39**. If this defrosting operation **1** is continued, the frost formed on second heat exchanger **29** dissolves completely and the temperature of the piping continues to rise. This temperature of the piping is continuously monitored by coil temperature sensor **52**, and the pattern is changed from defrosting operation **1** to the heating operation again when the temperature of the piping rises above a predetermined level. Then, operation of exhaust fan **14** that has been stopped is started at "strong notch"; the temperature of the refrigerant is monitored by coil temperature sensor **51** placed on the piping at the liquid side of first heat exchanger **26**; and operation of air supply fan **17** is also started at "predetermined notch" when a certain level of temperature is reached. This operation prevents the heating performance from excessively deteriorating at low temperature, allowing sufficient heating.

[0140] If defrosting is needed when the outdoor temperature is extremely low or the temperature in indoor space **1** is low, instead of defrosting operation **1** in which heating operation is once stopped and frost is removed by changing to defrosting operation, another defrosting operation is requested in which frost formed on second heat exchanger **29** is removed while continuing heating operation. Next, a description is made of such defrosting operation **2**.

[0141] In defrosting operation **2**, exhaust fan **14**, air supply fan **17**, compressor **40**, flow path changing valve **42**, open/close mechanism **48**, and the others all continue operation for heating operation. Then, first open/close valve **45** and second open/close valve **46** are changed from the closed state to the open state; the electronic expansion valve of expansion mechanism **41** is set to the fully closed state; and preheater **28** and refrigerant heater unit **47** are respectively operated. As a result that the settings are thus changed, a high temperature, high-pressure refrigerant compressed by compressor **40** passes through flow path changing valve **42** set to heating, and with first open/close valve **45** having been changed to the open state, the refrigerant is split into first heat exchanger **26** and first bypass circuit **43**. The refrigerant diverted to first heat exchanger **26** discharges heat into the air in indoor space **1** supplied from air supply fan **17**, and the air heated by the heat discharge of the refrigerant circulates in indoor space **1** to continue heating operation.

[0142] Meanwhile, as a result that the electronic expansion valve as expansion mechanism **41** is set to the fully closed state, and second open/close valve **46** interposed in second bypass circuit **44** is set to the open state, all the refrigerant flows through second bypass circuit **44** and flows into refrigerant heater unit **47**. Refrigerant heater unit **47** is provided with refrigerant heater **59** or refrigerant-water heat exchanger **66** as described above and heats the refrigerant to perform heat-absorbing operation.

[0143] On the other hand, the high-temperature, high-pressure refrigerant discharged from compressor **40** and diverted to first bypass circuit **43** flows into second heat exchanger **29**. As a result that exhaust fan **14** is operated at "strong notch", second heat exchanger **29** is supplied with outdoor air through air supply inlet **10** and air supply duct **11**.

[0144] Then, the refrigerant that has dissolved frost at second heat exchanger **29** merges with the refrigerant heated by refrigerant heater unit **47** to returns to compressor **40** through flow path changing valve **42**. After the air supplied to second heat exchanger **29** provides heat to the frost formed, the air is discharged to the outdoors through exhaust duct **9**. In this way, second heat exchanger **29** can be defrosted while continuing heating indoor space **1**. Then, the temperature of the piping of second heat exchanger **29** is monitored by coil temperature sensor **52** for a level higher than a predetermined value, and when the temperature rises to the level, namely when removing the frost completes, regular heating operation is resumed, allowing continuous heating operation without impairing comfortable feeling of users.

[0145] Next, a description is made of operation when the cooling operation is performed. The operation is an operation pattern used to lower the temperature in indoor space **1** at high temperature such as in summer to cool indoor space **1** for comfort or to reduce a cooling load on air-conditioner **18**. To perform this cooling operation, air path changing/adjusting unit **31** is set to the heating/cooling position at which exhaust air path **20** and supply air path **23** are arranged so that the air supplied from the outdoors passes through first heat exchanger **26** and exhaust from indoor space **1** passes through second heat exchanger **29**; and exhaust fan **14** and air supply fan **17** are operated at "strong notch".

[0146] Air supply bypass **32**, exhaust bypass **33**, dehumidification changer **34** are all set to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**, to the open state.

[0147] Refrigerant circuit **39** operates the compressor while adjusting the frequency according to the temperature of the air in indoor space **1** and the outdoors; retains flow path changing valve **42** to the cooling state; and adjusts expansion mechanism **41** to an appropriate degree of opening for an optimum refrigeration cycle when needed. Open/close mechanism **48** is set to the open state, and thus the refrigerant does not pass through capillary tube **49**. Refrigerant heater unit **47** is set to the stop state; and first open/close valve **45** and second open/close valve **46**, to the closed state.

[0148] In this state, as a result that air supply fan **17** is operated at "strong notch", a large volume of outdoor air enters air supply inlet **10** and passes through air supply duct **11**, air supply connection unit **21** of main body **7**, air supply open/close device **24**, outdoor filter **25**, and supply air path **23**. The large volume of outdoor air is retained in the cooling state and absorbs heat from the refrigerant compressed and conveyed by compressor **40** at fin-tube-type second heat exchanger **29** that has been changed to a "condenser". Then, the air is discharged to the outdoors through exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8** by air path changing/adjusting unit **31** set to the heating/cooling position.

[0149] Meanwhile, as a result that exhaust fan **14** is operated at "strong notch", a large volume of air in indoor space **1** passes through a hallway and/or the undercut of a door, and passes through exhaust air path **20** from air inlet **16** of grill **15** placed in the ceiling together with air in sanitary space **6**. Then, the air that has been heat-absorbed and cooled by the refrigerant at first heat exchanger **26** that has been changed to a "condenser" passes through air outlet connection unit **22** and air outlet duct **13** by air path changing/adjusting unit **31** set to the heating/cooling position, and is blown out from air outlet **12** into living room **2**.

[0150] Then, the refrigerant is changed to a gas of high pressure and temperature by compressor **40** operating at an appropriate frequency and is discharged to enter first heat exchanger **29** through flow path changing valve **42**, and discharges heat into a large volume of outdoor air to lower its temperature. The refrigerant is decompressed by expansion mechanism **41** to enter a two-phase state with low pressure and low temperature, becoming a low-temperature liquid. With open/close mechanism **48** in the open state, the refrigerant absorbs heat from a large volume of air sent from indoor space **1** to lower its temperature at entire first heat exchanger **26**, becoming a low-pressure, low-temperature gas; and then returns to compressor **40** through flow path changing valve **42**.

[0151] Moisture in indoor space **1** condenses into dew condensation water on the fins of first heat exchanger **29** (i.e. "vaporizer") and flows down to drain unit **35**. The accumulated dew condensation water is drained through drain piping **37** to such as the outdoors and a catch basin by operation of drain pump **36**. Instead, the dew condensation water is sprayed onto second heat exchanger **29** (i.e. "condenser"), and is vaporized and discharged when heat-exchanging the outdoor air.

[0152] Meanwhile, the insulation effect of heat insulator **38** around main body **7** prevents condensation and performance deterioration.

[0153] In this way, as a result that compressor **40** is operated at an appropriate frequency, the refrigerant circulates to second heat exchanger **29** and first heat exchanger **26**. As a result that air path changing/adjusting unit **31** is retained at the heating/cooling position; and exhaust fan **14** and air supply fan **17** are operated at "strong notch", a large volume of air is cooled, which results in the cooling operation in which indoor space **1** is cooled.

[0154] Next, a description is made of operation when the slightly dehumidifying heat-exchanging ventilation is performed. The operation is an operation pattern for recovering heat of air conditioned such as by air-conditioner **18** to a refrigerant when supplying indoor space **1** with outdoor fresh air while rapidly discharging smell and moisture in sanitary space **6**; and reheating and dehumidifying indoor space **1** while heating air supplied from the outdoor and sending the air, to improve comfort against high humidity during a rainy season or against humidification by households and to restrain mold on such as a wall surface.

[0155] During this operation, exhaust fan **14** and air supply fan **17** are operated at "strong notch" while adjusting air path changing/adjusting unit **31** to an appropriate degree of opening between the heating/cooling position and the air supply/exhaust position (the state shown in the figure). Then, adjustment is made for each air volume of outdoor air passing through first heat exchanger **26** and second heat exchanger **29**; and that in indoor space **1**. Here, the heating/cooling position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are set so that air from the outdoors passes through first heat exchanger **26**; and exhaust from indoor space **1**, through second heat exchanger **29**. The air supply/exhaust position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are secured.

[0156] Air supply bypass **32**, exhaust bypass **33**, and dehumidification changer **34** are all set to the closed state; auxiliary heater **27** and preheater **28**, to the stop state; and air supply open/close device **24** and exhaust open/close device **30**; to the open state.

[0157] Refrigerant circuit **39** operates compressor **40** while adjusting the frequency according to the temperature and humidity of the air in indoor space **1** and the outdoors; retains flow path changing valve **42** to the heating state; and sets expansion mechanism **41** to the fully open state. Open/close mechanism **48** is set to the closed state and passes the refrigerant flow through capillary tube **49** to be decompressed; the upstream side of first heat exchanger **26** from capillary tube **49** is used as a "condenser"; and the downstream, as a "vaporizer". Refrigerant heater unit **47** is set to the stop state; and first open/close valve **45** and second open/close valve **46**, to the closed state.

[0158] In this state, as a result that air supply fan **17** is operated at "strong notch", a large volume of air in indoor space **1** passes through a hallway and/or the undercut of a door, and passes through exhaust air path **20** from air inlet **16** of grill **15** placed in the ceiling together with air in sanitary space **6**. A large volume of outdoor air passes through air supply duct **11**. The air flows merge with their air volumes adjusted by air path changing/adjusting unit **31** having been set to "adjusting the degree of opening". The air merged is dehumidified at the downstream side from capillary tube **49**, of first heat exchanger **26** that has been set to the heating state by flow path changing valve **42** to become a "vaporizer"; and reheated at the upstream side from capillary tube **49**, of first heat exchanger **26** that has become a "condenser". The air dehumidified and reheated is blown out from air outlet **12** into living room **2** through air outlet connection unit **22** and air outlet duct **13**.

[0159] Then, as a result that exhaust fan **14** is operated at "strong notch", a large volume of outdoor air enters air supply inlet **10** and passes through air supply duct **11**, air supply connection unit **21** of main body **7**, air supply open/close device **24**, outdoor filter **25**, and supply air path **23**. Meanwhile, a large volume of air in indoor space **1** passes through exhaust air path **20** from air inlet **16** of grill **15**. The air flows merge with their air volumes adjusted by air path changing/adjusting unit **31** having been set to "adjusting the degree of opening". The air merged is heat-absorbed by the refrigerant at second heat exchanger **29** retained in the heating state by flow path changing valve **42** to become a "vaporizer"; and discharged to the outdoors through exhaust open/close device **30**, exhaust connection unit **19**, exhaust duct **9**, and exhaust outlet **8**.

[0160] The refrigerant is changed to a gas of high pressure and temperature by compressor **40** operating at an appropriate frequency and is discharged to enter first heat exchanger **29** through flow path changing valve **42**. With open/close mechanism **48** in the closed state, the refrigerant discharges heat into a large volume of air in indoor space **1** and from the outdoors, at the upstream side from capillary tube **49**, of first heat exchanger **26** to decrease its temperature, entering a two-phase state with medium-low temperature. Further, the refrigerant is decompressed at capillary tube **49**, entering a two-phase state with medium-low pressure and medium-low temperature. Next, the refrigerant slightly absorbs heat from a large volume of air in indoor space **1** and from the outdoors at the downstream side of first heat exchanger **26** from capillary tube **49**, entering a two-phase state with medium-low pressure and medium-low temperature. With decompression mechanism **41** in the fully open state, the refrigerant is slightly decompressed to enter second heat exchanger **29** (i.e. "vaporizer"); further absorbs heat from a large volume of air from the outdoors and indoor space **1**, becoming a low-pressure, low-temperature gas; and returns to compressor **40**.

[0161] Moisture in indoor space **1** and the outdoors condenses into dew condensation water at the downstream part of first heat exchanger **26** (i.e. "vaporizer") from capillary tube **49** and on the fins of second heat exchanger **29**, and flows down to drain unit **35**. The accumulated dew condensation water is drained through drain piping **37** to such as the outdoors and a catch basin by operation of drain pump **36**.

[0162] Meanwhile, the insulation effect of heat insulator **38** around main body **7** prevents condensation and performance deterioration.

[0163] In this way, as a result that compressor **40** is operated at an appropriate frequency, the refrigerant circulates to the upstream part of first heat exchanger **26** from capillary tube **49**, capillary tube **49**, the downstream part from capillary tube **49**, and second heat exchanger **29**. Air path changing/adjusting unit **31** is retained at "adjusting the degree of opening"; and exhaust fan **14** and air supply fan **17** are operated at "strong notch", which results in the slightly dehumidifying heat-exchanging ventilation, in which heat in indoor space **1** is recovered to be reheated and dehumidified; and sanitary space **6** is exhausted and supplied with outdoor air.

[0164] Next, a description is made of operation when the slightly heating heat-exchanging ventilation is performed. The operation is an operation pattern for recovering heat of air conditioned such as by air-conditioner **18** when supplying indoor space **1** with outdoor fresh air while rapidly discharging smell and moisture in sanitary space **6**; and heating indoor space **1** while heating air supplied from the outdoor and sending the air, to improve comfort in winter or to reduce a heating load on air-conditioner **18**.

[0165] During this operation, exhaust fan **14** and air supply fan **17** are operated at "strong notch" while adjusting air path changing/adjusting unit **31** to an appropriate degree of opening between the heating/cooling position and the air supply/exhaust position (the state shown in the figure). Then, adjustment is made for each air volume of outdoor air passing through first heat exchanger **26** and second heat exchanger **29**; and that in indoor space **1**. The other operation is the same as that of the heating. Here, the heating/cooling position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are set so that air from the outdoors passes through first heat exchanger **26** and exhaust from indoor space **1** passes through second heat exchanger **29**. The air supply/exhaust position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are secured.

[0166] Next, a description is made of operation when the slightly cooling heat-exchanging ventilation is performed. The operation is an operation pattern for recovering heat of air conditioned such as by air-conditioner **18** when supplying indoor space **1** with outdoor fresh air while rapidly discharging smell and moisture in sanitary space **6**; and for cooling indoor space **1** with the refrigerant absorbing heat from air supplied from the outdoors, to improve comfort in summer or to reduce a cooling load on air-conditioner **18**.

[0167] During this operation, exhaust fan **14** and air supply fan **17** are operated at "strong notch" while adjusting air path changing/adjusting unit **31** to an appropriate degree of opening between the heating/cooling position and the air supply/exhaust position (the state shown in the figure). Then, adjustment is made for each air volume of outdoor air passing through first heat exchanger **26** and second heat exchanger **29**; and that in indoor space **1**. The other operation is the same as that of the cooling. Here, the heating/cooling position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are set so that air from the outdoors passes through first heat exchanger **26** and exhaust from indoor space **1** passes through second heat exchanger **29**. The air supply/exhaust position of air path changing/adjusting unit **31** refers a state in which exhaust air path **20** and supply air path **23** are secured.

[0168] With the configuration and operation described hereinbefore, the ventilating air-conditioning system according to the embodiment of the present invention presents the following effects.

[0169] The system transfers air through a refrigerant between first heat exchanger **26** and second heat exchanger **29**; and heats or cools outdoor air to supply indoor space **1** with the air by air supply fan **17** while discharging air in bathroom **3** by exhaust fan **14**. This operation prevents outdoor air not conditioned from flowing into indoor space **1**, thereby improving comfort, preventing mold from growing due to condensation near a natural air inlet, and preventing a wall surface from becoming dirty due to dust in outdoor air. Further, with heat exchange between air and the refrigerant by the heat exchanger, saving energy is totally achieved including reducing running costs of air-conditioner **18**. The low pressure loss of the heat exchanger increases the air volume for ventilating.

[0170] Air path changing/adjusting unit **31** adjusts each amount of outdoor air passing through first heat exchanger **26** and second heat exchanger **29**; and that in the sanitary space to balance each amount of ventilation air, exhaust, and supply air according to environmental conditions such as indoor and outdoor temperature, indoor and outdoor humidity, and the pollution level of indoor air. This operation allows supplying indoor space **1** with air while ventilating sanitary space **6**, which allows air-conditioning with low energy.

[0171] The system sets air supply bypass **32** of first heat exchanger **26** and exhaust bypass **33** of second heat exchanger **29** to the open state during ventilation to supply and discharge air between indoor space **1** and the outdoors without passing part of air in the outdoors and sanitary space **6** through first heat exchanger **26** and second heat exchanger **29**. This operation allows supplying indoor space **1** with air and exhausting sanitary space **6** with lower power for the same air volume of supply and exhaust.

[0172] The system changes the air path so that air drawn from sanitary space **6** is cooled at second heat exchanger **29**; reheated at first heat exchanger **26**; and blown out into indoor space **1**, thereby reducing temperature changes in indoor space **1** and dehumidifying indoor space **1** while reducing heat flowing out to the outdoors.

[0173] Flow path changing valve **42** changes the direction in which the refrigerant flows, which allows switching between heating and cooling in indoor space **1**.

[0174] The system operates so that air drawn from the outdoors is cooled at the downstream side of first heat exchanger **26** from decompression unit **50**, reheated at the upstream side from decompression unit **50**, and then blown out into indoor space **1**, which allows dehumidifying indoor space **1** without excessively decreasing the temperature in indoor space **1** while introducing outdoor fresh air into indoor space **1**.

[0175] When heating, cooling, or dehumidifying indoor space **1**, the system increases the air volume of air supply fan **17** or exhaust fan **14**, unlike when ventilating sanitary space **6**, thereby increasing the performance of recovering heat, and ventilating and air-conditioning with lower power consumption.

[0176] Air conditioned by air-conditioner **18** placed at a location other than sanitary space **6** enters air inlet **16** to sanitary space **6**, and the heat of the air is recovered. Hence, heat is used of the air blown out from air-conditioner **18** more efficient than the ventilating air-conditioning system, thereby downsizing the heat exchanger inside main body **7** and saving energy during air-conditioning operation.

[0177] Drain unit **35** arranged under supply air path **23** and exhaust air path **20** reliably disposes of dew condensation water generated in the air path; condensate water from the heat exchanger flows to a single drain outlet to improve workability. Further, an increased amount of water allows the water to flow into the drain outlet smoothly to prevent retained water from developing bacteria.

[0178] Operating drain pump **36** allows condensate water or dew condensation water to be drained to a position higher than drain unit **35**, thereby enabling the system to be constructed where the drain cannot be sloped adequately due to a small roof space.

[0179] Insulating around supply air path **23** and exhaust air path **20** with heat insulator **38** prevents heat from leaking while preventing condensation from forming on the outer shell of main body **7** of the ventilating air-conditioning system, thereby further saving energy.

[0180] The inside of main body **7** of the ventilating air-conditioning system placed such as in the roof space of bathroom **3** contains all of compressor **40**, first heat exchanger **26**, expansion mechanism **41**, and second heat exchanger **29** composing refrigerant circuit **39** to save space and to improve workability.

[0181] Auxiliary heater **27** heats at least part of the air sent by air supply fan **17**, thereby covering deficiency in the heating performance in a low-temperature environment.

[0182] Preheater **28** preheats air before being supplied to second heat exchanger **29**, thereby restraining the heating performance from decreasing in a low-temperature environment and second heat exchanger **29** from being frosted, as well as removing frost formed.

[0183] When frost forms on first heat exchanger **26** or second heat exchanger **29** at low temperature, the system changes flow path changing valve **42** according to the temperature of a refrigerant monitored by coil temperature sensors **51**, **52**, thereby removing frost formed.

[0184] When frost forms on second heat exchanger **29** at low temperature, the system opens the high- and low-pressure sides of refrigerant circuit **39** through first bypass circuit **43** and second bypass **44** to allow a high-temperature refrigerant to circulate to second heat exchanger **29**; or increases the refrigerant pressure in second heat exchanger **29**, thereby removing frost formed.

[0185] Refrigerant heater unit **47** is interposed in refrigerant circuit **39** in series or parallel with second heat exchanger **29**; and refrigerant heater unit **47** is activated when the heat-absorbing performance decreases such as due to frost forming on second heat exchanger **29**, thereby securing the heat-absorbing performance to maintain the heating performance.

[0186] Refrigerant heater unit **47** includes refrigerant heater **59** heating a refrigerant electrothermally, thereby downsizing refrigerant heater unit **47**.

[0187] Refrigerant heater unit **47** includes refrigerant-water heat exchanger **66** heating a refrigerant by heat exchange with hot water from water heater **67**, thereby reducing power usage at refrigerant heater unit **47**.

[0188] Using hot water heated by a heat pump water heater for hot water to be supplied to refrigerant-water heat exchanger **66** further reduces power usage at refrigerant heater unit **47**.

[0189] When draining hot water that has undergone heat exchange with a refrigerant by refrigerant-water heat exchanger **66**, a drain path is used for draining dew condensation water generated in first heat exchanger **26** and/or second heat exchanger **29**, thereby simplifying construction without increasing the number of drain paths.

[0190] Arrangement is made so that a refrigerant discharges heat to normal-temperature water supplied to refrigerant-water heat exchanger **66** in case where the discharge heat performance decreases at high temperature such as in summer, thereby resolving deficiency in heat discharge to maintain the cooling performance.

[0191] The above description is made only for one embodiment of the present invention, which is not limited to the above embodiment.

[0192] For instance, in the above-described embodiment of the present invention, indoor space **1** to be air-supplied and air-conditioned is living room **2**; sanitary space **6** having air outlet opening is bathroom **3**; however, a space to be air-supplied and air-conditioned and a space having an air outlet opening are not limited to the above, but may be any space as long as it is partitioned within indoor space **1**. For instance, a space air-supplied and air-conditioned may be a hallway; a space having an air outlet opening, washroom **4**.

[0193] In the above-described embodiment of the present invention, air outlet **12** and air inlet **16** respectively open to living room **2** and bathroom **3** one each; however, the numbers of air outlets **12** and air inlets **16** are not limited to the above case. For instance, two air outlets **12** may open to living room **2** and a hallway.

[0194] In the above-described embodiment of the present invention, air inlet **16** for exhausting is a cassette-type one provided in grill **15** of main body **7**; however, it may be a concealed type one in which a duct is connected to air inlet **16** of main body **7**, the end of the duct is connected to another air inlet in the ceiling of a space to be exhausted, and main body **7** is concealed in the roof space.

[0195] In the above-described embodiment of the present invention, refrigerant circuit **39** is provided with two-series bypass circuits (first bypass circuit **43** and second bypass circuit **44**); however, it may be provided with one-series bypass circuit.

[0196] In the above-described embodiment of the present invention, refrigerant heater unit **47** is placed in parallel with second heat exchanger **29**; however, it may be interposed in series with second heat exchanger **29** within refrigerant circuit **39**.

[0197] In the above-described embodiment of the present invention, the configuration is shown in which first open/close valve **45** and second open/close valve **46** are changed between the two levels (open and closed); however, the open/close valve may be any type as long as it opens and closes a bypass circuit such as an electronic expansion valve.

[0198] In the above-described embodiment of the present invention, the configuration is shown in which open/close mechanism **48** is placed in parallel with capillary tube **49** as a decompression unit; however, the decompression unit may be any type as long as it can change the decompression action such as a type with an electronic expansion valve interposed.

[0199] In the above-described embodiment of the present invention, two types of configurations (i.e. refrigerant heater **59** and refrigerant-water heat exchanger **66**) are shown as a concrete configuration of refrigerant heater unit **47**; however, refrigerant heater unit **47** may be any type as long as it can heat a refrigerant, not limited to the above-described two types.

[0200] In the above-described embodiment of the present invention, the configuration is shown in which the piping at the water side of refrigerant-water heat exchanger **66** is supplied with hot water from a combustion water heater or heat pump water heater; however, the piping may be supplied with high-temperature water (e.g. 40° C. to 90° C.) or normal-temperature feed water (e.g. 1° C. to 40° C.), not limited to hot water from a combustion water heater or heat pump water heater. Any type of water may be used such as hot water or feed water from a gas water heater, electricity water heater, kerosene water heater; circulating water such as for heating floors; normal-temperature city water; or water left in the bathtub.

[0201] In the above-described embodiment of the present invention, the motor of air supply fan **17**, exhaust fan **14**, or compressor **40** is not particularly mentioned (e.g. AC or DC); however, a DC motor particularly saves energy.

[0202] In the above-described embodiment of the present invention, compressor **40** has two rotors and is placed in the horizontal position; however, compressor **40** may be scrolltype as long as it is low-vibration type, and may be placed in a vertical position as long as it is low-profile type.

[0203] In the above-described embodiment of the present invention, the configuration is shown in which main body **7** is suspended in the roof space of bathroom **3** for installation; however, it may be installed at any location and in any way as long as a space for installing the main body, maintainability, sound insulation, and vibration insulation are secured. For instance, floor-standing main body **7** may be placed in an indoor or outdoor machine room or embedded in a wall surface.

INDUSTRIAL APPLICABILITY

[0204] As described above, a ventilating air-conditioning system according to the present invention saves space and improves workability; and recovers heat from the air while rapidly discharging a large volume of air containing moisture and smell generated from a sanitary space. The system air-conditions an indoor space while supplying outdoor fresh air to allow air-conditioning with low energy consumption while improving air quality. Consequently, besides ventilating a sanitary space and air-supplying/air-conditioning an indoor space, the invention is applicable to a ventilating, air-supplying, and air-conditioning system for a living space such as a living room, bedroom, kitchen, and washroom; an uninhabitable space such as a closet, underfloor, and storage; and a nonresidential space such as an office, meeting room, and warehouse.

TABLE 1

	Operation pattern					
Main component	Heat-exchanging ventilate	Air supply/ exhaust	Air supply	Exhaust	Dehumidify	Heat
Exhaust fan (14)	Strong notch	Weak notch	Stop	Weak notch	Stop	Strong notch
Air path switching/adjusting unit (31)	Air supply/ exhaust position	Air supply/ exhaust position	Air supply/ exhaust position	Air supply/ exhaust position	Air supply/ exhaust position	Heat/cool position
Air supply fan (17)	Strong notch	Weak notch	Weak notch	Stop	Strong notch	Strong notch
Compressor (40)	Lowest Hz	Stop	Stop	Stop	Adjust Hz	Adjust Hz
Flow path changing valve (42)	Heat or cool	Stop	Stop	Stop	Heat	Heat
Expansion mechanism (41) (electronic expansion valve)	Adjust degree of opening	Stop	Stop	Stop	Adjust degree of opening	Adjust degree of opening
Air supply bypass (32)	Closed	Open	Open	Open	Closed	Closed
Exhaust bypass (33)	Closed	Open	Open	Open	Closed	Closed
Dehumidification changer (34)	Closed	Closed	Closed	Closed	Open	Closed
Auxiliary heater (27)	Stop	Stop	Stop	Stop	Stop	Stop
Preheater (28)	Stop	Stop	Stop	Stop	Stop	Stop
Refrigerant heater unit (47)	Stop	Stop	Stop	Stop	Stop	Stop
Air supply open/close device (24)	Open	Open	Open	Open	Closed	Open
Exhaust open/close device (30)	Open	Open	Open	Open	Closed	Open
Drain pump (36)	Operate	Stop	Stop	Stop	Operate	Operate
Open/close mechanism (48)	Open	Stop	Stop	Stop	Open	Open
First open/close valve (45)	Closed	Stop	Stop	Stop	Closed	Closed
Second open/close valve (46)	Closed	Stop	Stop	Stop	Closed	Closed

TABLE 2

Main component	Operation pattern					
	Defrost 1	Defrost 2	Cool	Slightly dehumidifying heat-exchanging ventilate	Slightly heating heat-exchanging ventilate	Slightly cooling heat-exchanging ventilate
Exhaust fan (14)	Stop	Strong notch	Strong notch	Strong notch	Strong notch	Strong notch
Air path switching/adjusting unit (31)	Heat/cool position	Heat/cool position	Heat/cool position	Adjust degree of opening	Adjust degree of opening	Adjust degree of opening
Air supply fan (17)	Stop	Strong notch	Strong notch	Strong notch	Strong notch	Strong notch
Compressor (40)	Adjust Hz	Adjust Hz	Adjust Hz	Adjust Hz	Adjust Hz	Adjust Hz
Flow path changing valve (42)	Cool	Heat	Cool	Heat	Heat	Cool
Expansion mechanism (41) (electronic expansion valve)	Adjust degree of opening	Fully closed	Adjust degree of opening	Fully open	Adjust degree of opening	Adjust degree of opening
Air supply bypass (32)	Closed	Closed	Closed	Closed	Closed	Closed
Exhaust bypass (33)	Closed	Closed	Closed	Closed	Closed	Closed
Dehumidification changer (34)	Closed	Closed	Closed	Closed	Closed	Closed
Auxiliary heater (27)	Stop	Operate	Stop	Stop	Stop	Stop
Preheater (28)	Stop	Operate	Stop	Stop	Stop	Stop
Refrigerant heater unit (47)	Stop	Operate	Stop	Stop	Stop	Stop
Air supply open/close device (24)	Open	Open	Open	Open	Open	Open
Exhaust open/close device (30)	Open	Open	Open	Open	Open	Open
Drain pump (36)	Operate	Operate	Operate	Operate	Operate	Operate
Open/close mechanism (48)	Open	Stop	Stop	Closed	Open	Open
First open/close valve (45)	Closed	Open	Closed	Closed	Closed	Closed
Second open/close valve (46)	Closed	Open	Closed	Closed	Closed	Closed

1. A ventilating air-conditioning system comprising:

an air supply fan drawing in outdoor air through an air inlet open to outdoors and blowing out the outdoor air through an air outlet open to an indoor space;

an exhaust fan drawing in air in a sanitary space through an air inlet open to the sanitary space and blowing out the air in the sanitary space through an air outlet open to the outdoors;

a compressor compressing a refrigerant;

a first heat exchanger heat-exchanging between the outdoor air sent by the air supply fan and the refrigerant;

an expansion mechanism expanding the refrigerant;

a second heat exchanger heat-exchanging between air in the sanitary space sent by the exhaust fan and the refrigerant; and

a refrigerant circuit piped so that the refrigerant circulates in order of the compressor, the first heat exchanger, the expansion mechanism, and the second heat exchanger, or in order of the compressor, the second heat exchanger, the expansion mechanism, and the first heat exchanger,

wherein the system heats or cools the indoor space while ventilating the sanitary space by transferring heat between the first heat exchanger and the second heat exchanger through the refrigerant.

2. The ventilating air-conditioning system of claim **1**, further comprising:

a decompression unit decompressing the refrigerant at piping through which the refrigerant in the first heat exchanger flows.

3. The ventilating air-conditioning system of claim **1**, wherein a larger volume of air is sent from the supply fan or the exhaust fan when heating, cooling, or dehumidifying the indoor space than when ventilating the sanitary space.

4. The ventilating air-conditioning system of claim **1**, wherein the indoor space is provided therein with an air-conditioner for controlling temperature of the indoor space, and air in the sanitary space drawn into the air inlet is air conditioned by the air-conditioner.

5. The ventilating air-conditioning system of claim **1**, further comprising:

an auxiliary heater heating at least part of the outdoor air sent by the air supply fan.

6. The ventilating air-conditioning system of claim **1**, further comprising:

a preheater preheating air drawn in from the sanitary space.

7. The ventilating air-conditioning system of claim **1**, further comprising:

a coil temperature sensor detecting temperature of the refrigerant in the first heat exchanger and the second heat exchanger at a side of the expansion mechanism.

8. The ventilating air-conditioning system of claim **1**, further comprising:

a supply air path including an air supply connection unit connected to an air supply duct communicating with the air inlet, an air outlet connection unit connected to an exhaust duct communicating with the air outlet, and the first heat exchanger, and communicating between the air supply connection unit and the air outlet connection unit;

an exhaust air path including an exhaust connection unit connected to an exhaust duct communicating with the air outlet and the second heat exchanger, and communicating between the exhaust connection unit and the air inlet; and

an air path changing and adjusting unit communicating or blocking between an upstream side of the first heat exchanger and an upstream side of the second heat exchanger, or adjusting an amount of communication.

9. The ventilating air-conditioning system of claim **8**, further comprising:

an air supply bypass blowing out part of the outdoor air into the indoor space, in the supply air path; and

an exhaust bypass discharging part of air in the sanitary space into the outdoors, in the exhaust air path.

10. The ventilating air-conditioning system of claim **8**, further comprising:

a dehumidification changer communicating or blocking between a downstream side of the second heat exchanger and a downstream side of the first heat exchanger, or adjusting an amount of communication, in the exhaust air path.

11. The ventilating air-conditioning system of claim **8**, further comprising:

a drain unit draining or vaporizing dew condensation water generated in the first heat exchanger and the second heat exchanger, at bottoms of the supply air path and the exhaust air path.

12. The ventilating air-conditioning system of claim **11**, further comprising:

a drain pump draining water stored in the drain unit.

13. The ventilating air-conditioning system of claim **8**, wherein the supply air path and the exhaust air path including outer shells thereof are heat-insulated.

14. The ventilating air-conditioning system of claim **1**, further comprising:

a flow path changing valve changing a flow direction of the refrigerant from order of the compressor, the first heat exchanger, the expansion mechanism, and the second heat exchanger, to order of the compressor, the second heat exchanger, the expansion mechanism, and the first heat exchanger.

15. The ventilating air-conditioning system of claim **14**, wherein the refrigerant circuit includes:

a first bypass circuit splitting from piping connecting the flow path changing valve to the first heat exchanger, and joining piping connecting the expansion mechanism to the second heat exchanger; and

a second bypass circuit splitting from piping connecting the first heat exchanger to the expansion mechanism, and joining piping connecting the second heat exchanger to the flow path changing valve,

wherein the first bypass circuit includes a first open and close valve opening and closing the first bypass circuit, and the second bypass circuit includes a second open and close valve opening and closing the second bypass circuit.

16. The ventilating air-conditioning system of claim **15**, further comprising:

a refrigerant heater unit heating a refrigerant in the second bypass circuit in series or parallel with the second heat exchanger.

17. The ventilating air-conditioning system of claim **16**, wherein the refrigerant heater unit is a refrigerant heater heating the refrigerant by making an electrothermal tube generate heat.

18. The ventilating air-conditioning system of claim **16**, wherein the refrigerant heater unit is a refrigerant-water heat exchanger with a refrigerant pipe line, through which the refrigerant flows, inside a hot-water pipe line through which hot water flows.

19. The ventilating air-conditioning system of claim **18**, wherein hot water used for the refrigerant-water heat exchanger is heated by a heat pump water heater.

20. The ventilating air-conditioning system of claim **18**, wherein the hot water is drained through the drain unit.

21. The ventilating air-conditioning system of claim **18**, wherein the refrigerant-water heat exchanger is supplied with normal-temperature water.

22. The ventilating air-conditioning system of claim **19**, wherein the hot water is drained through the drain unit.

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